Thesis 2 Presentation
Spring 1995

Modelling and Simulating Congestion Control in Wide-Area TCP Networks using BONeS

Matthew Gream
(90061060)

Agenda:

Investigation and Objectives
BONeS Environment
Overview of Simulations
Simulation: TCP/CC in multi-path WAN
Simulation: TCP/CC and overloaded WAN
Level of Completion
Conclusions and Future Directions
Question Time

(16 minutes)

Primary Areas of Investigation:

- TCP congestion control
- WAN traffic characteristics

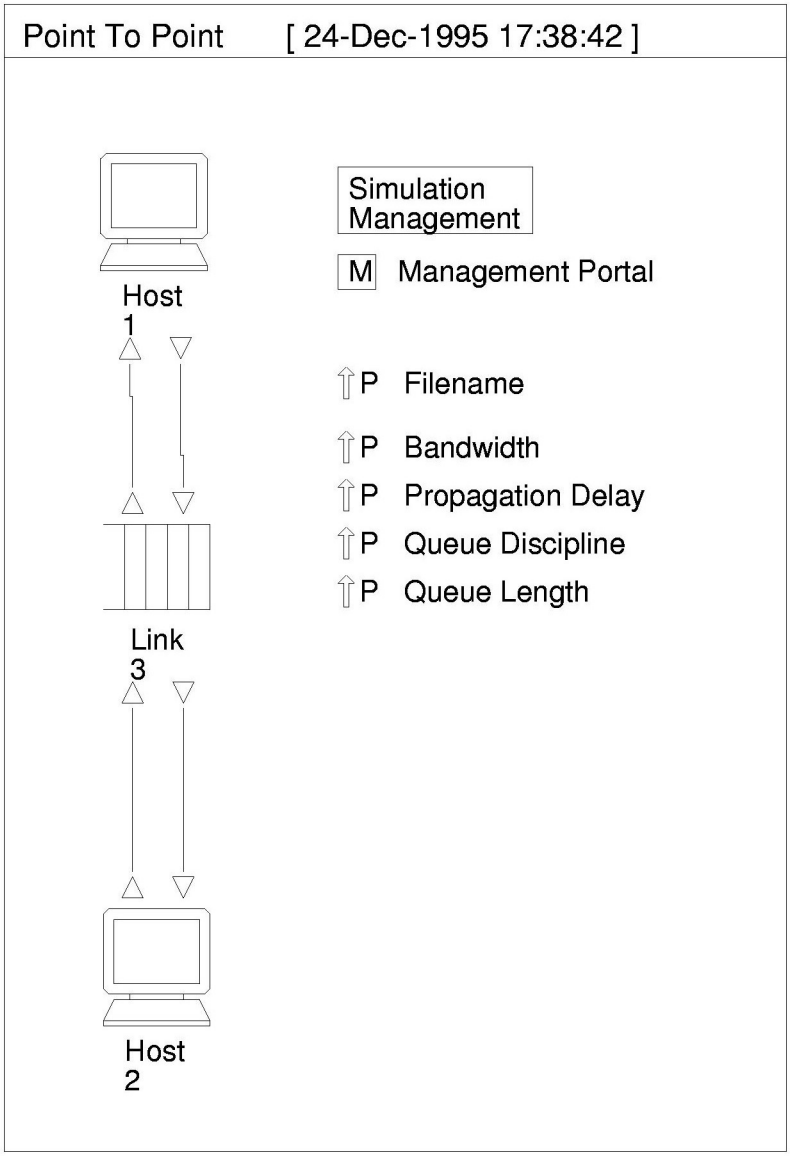
Objectives:

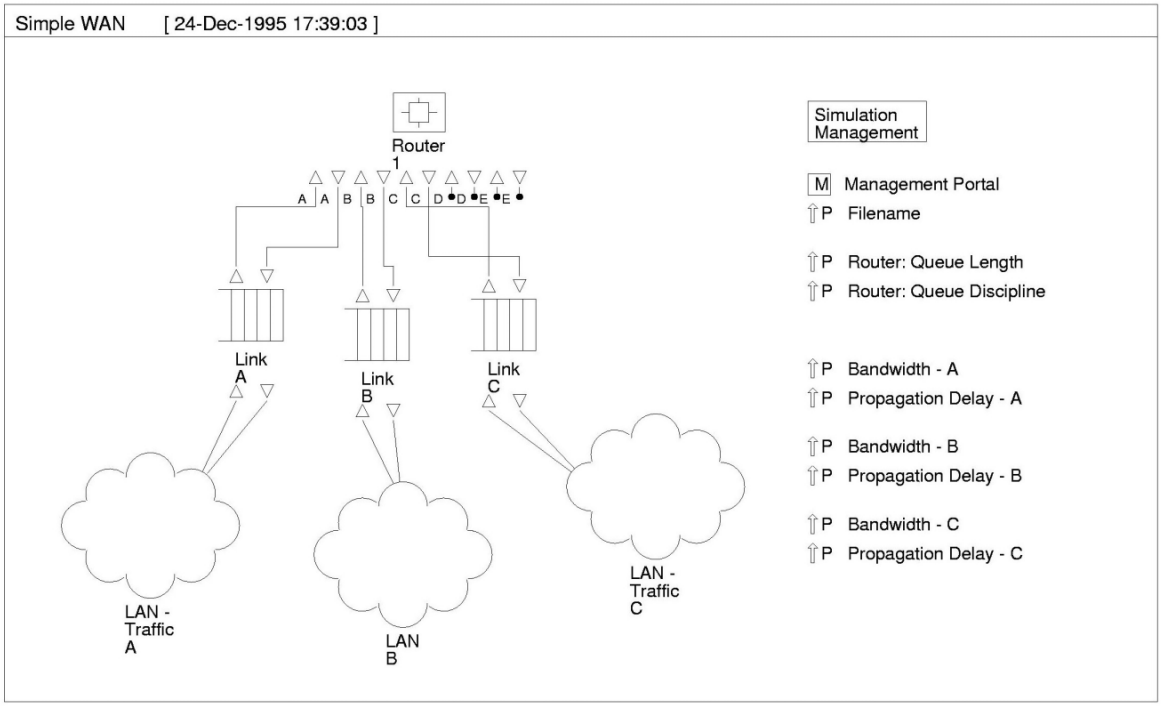
- Construct a BONeS environment to support the modelling and simulation of Wide-Area TCP congestion scenarios. It should be presentable, re-usable and configurable.
- Use the environment to model, simulate and analyse Wide-Area TCP congestion scenarios,
    - Examine and describe the basic nature of TCP congestion control.
    - Examine the effects of new WAN environments on TCP congestion control.
        - Increasing complexity of WANs,
        - Increasing utilisation of WANs,
        - Changing nature of traffic profiles.

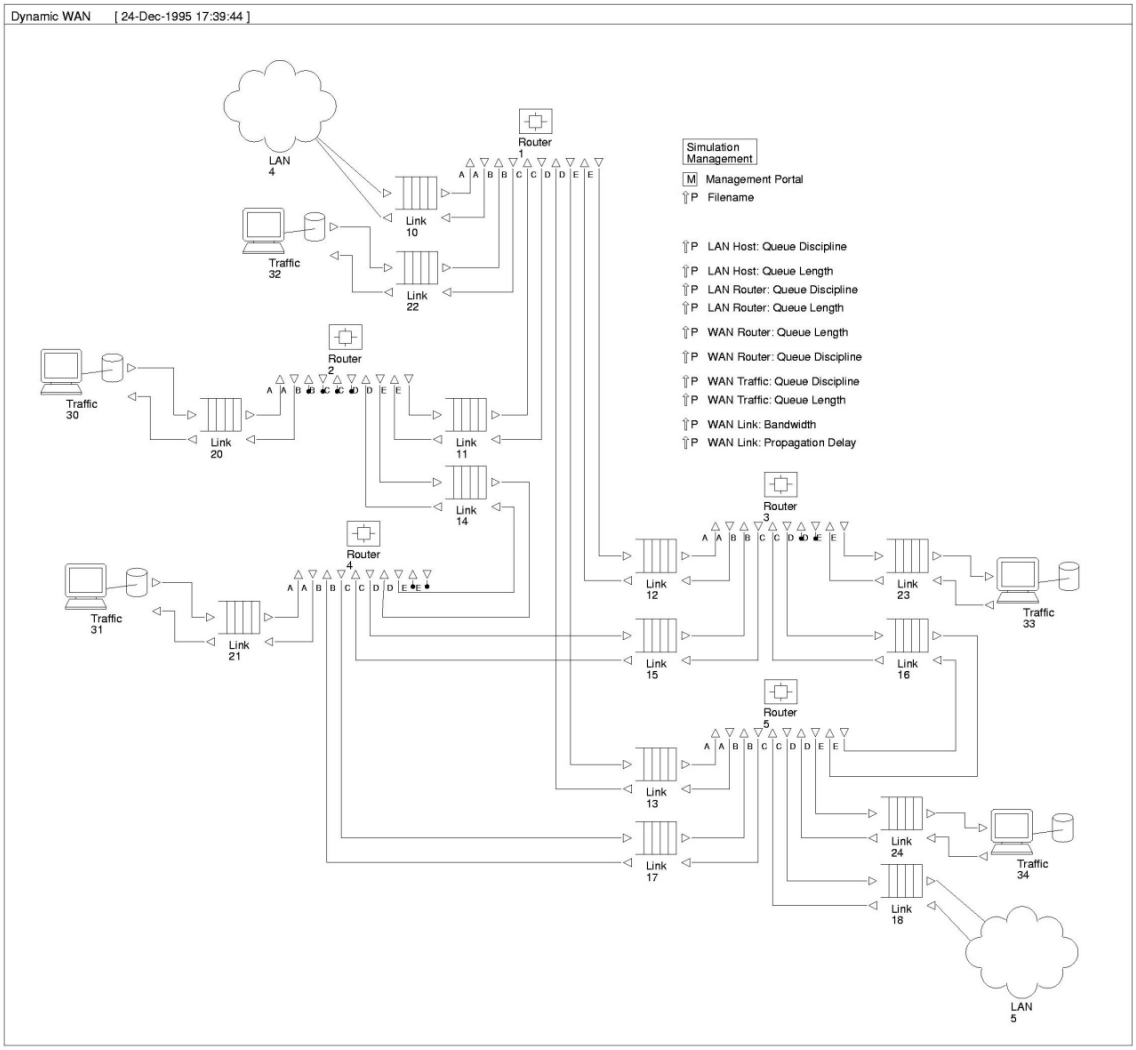
BONeS Environment, Features:

- Provides basic network components: Host, Traffic Generator, Link, LAN.
- Supports different queue drop policies: Drop Random, Drop Tail and Random Early Detection.
- Supports different queue extraction policies: Address Fair Queueing, Class Priority and Size Priority.
- Has defacto standard BSD 4.4/Net3 TCP, with most recent congestion control modifications: the main research platform.
- Executes simulation using commands read from a management file, allowing for otherwise difficult dynamic behaviour.
- Generates Traffic from statistical distributions or by using TCPLIB based traffic profiles (e.g. ‘Telnet’, ‘FTP’).

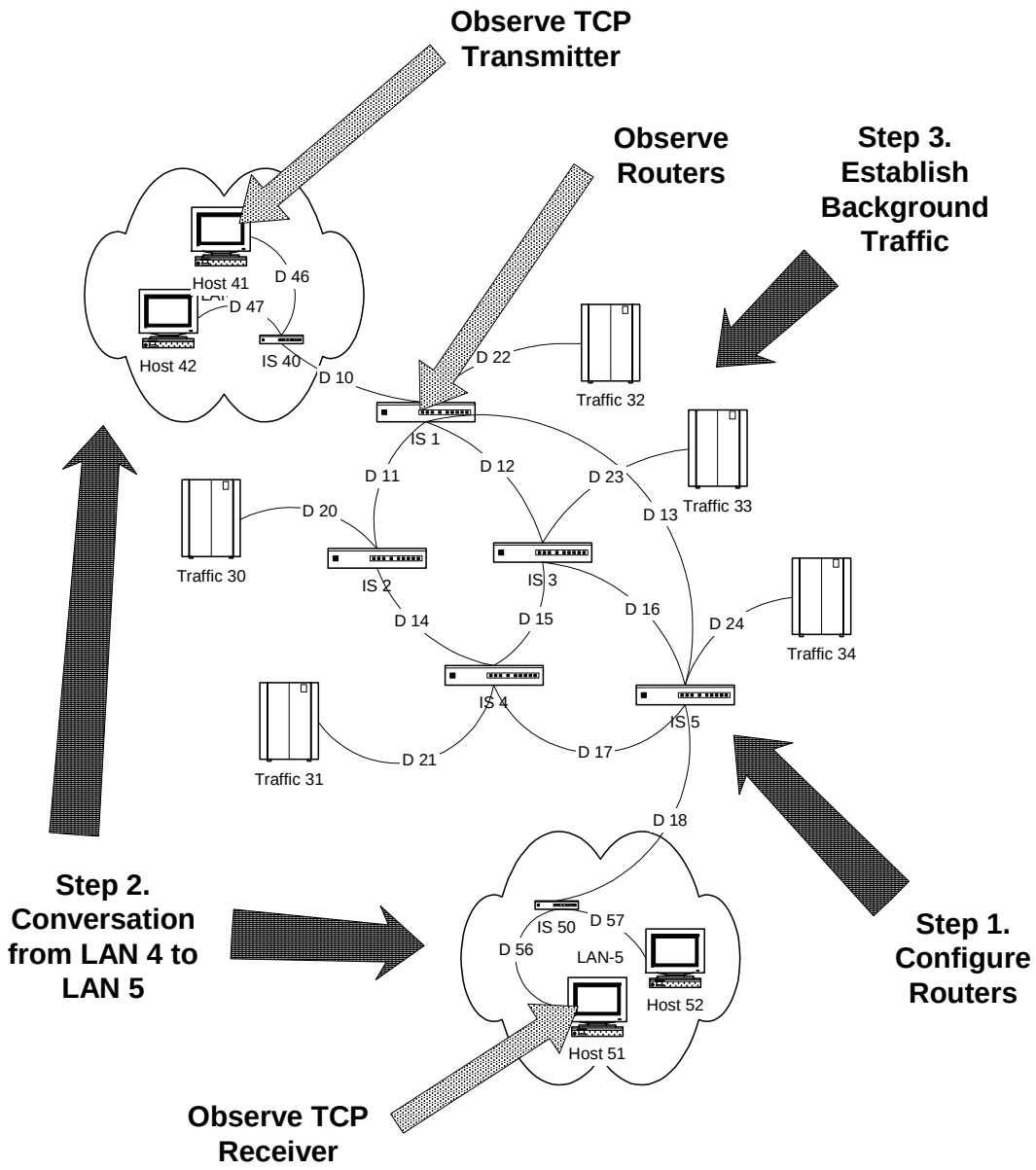
Simulation	*Objectives*	*Expectations*
Single TCP conversation	Verification/validation. Behaviour explanation.	Basic congestion window nature. Decreased throughput on queue size increase.
Competing TCP conversations in WAN environment	Verification/validation. Behaviour explanation. Examination effects of RTT differences.	RTT bias, Throughput reduction, ACK compression.
TCP conversations in multiple-path, dynamically-routed WAN environment	Investigate performance. Examine effects of background traffic.	Increased retransmissions, Throughput reduction, ACK compression, Instability.
TCP conversations in overloaded WAN	Investigate performance. Examine window granularity problem, Predict breakdown threshold. Examine effects of increased queueing.	Breakdown at threshold, Increase in retransmissions, High retransmission ratios
TCP conversations with HTTP traffic in WAN environment	Investigate performance. Compare with Telnet traffic profiles.	(not completed)

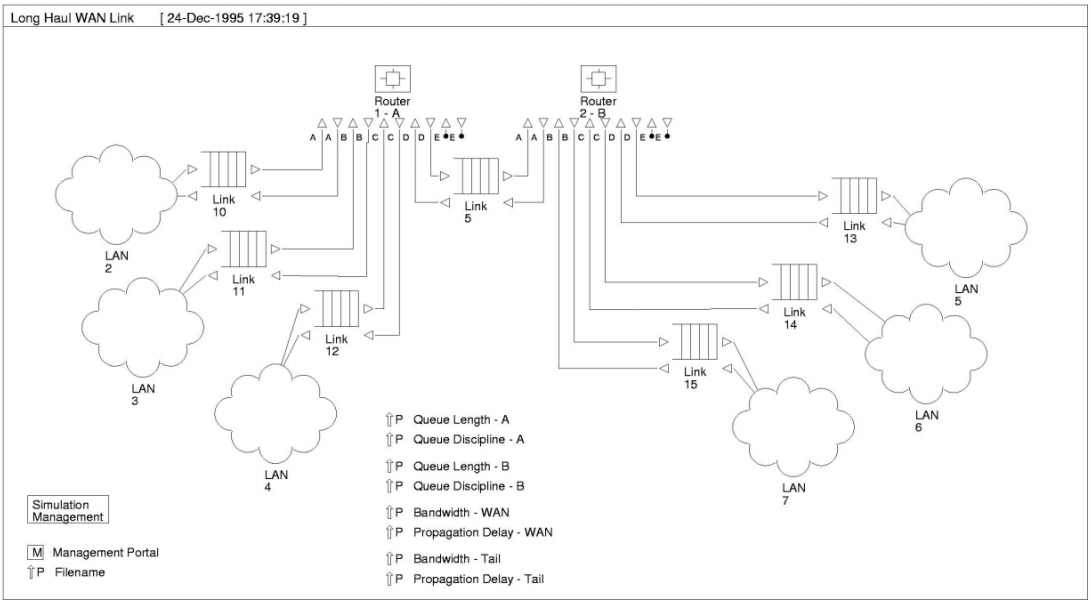

Point To Point [24-Dec-1995 17:38:42]
Host 1
Link 3
Host 2
Simulation Management
M Management Portal
P Filename
P Bandwidth
P Propagation Delay
P Queue Discipline
P Queue Length

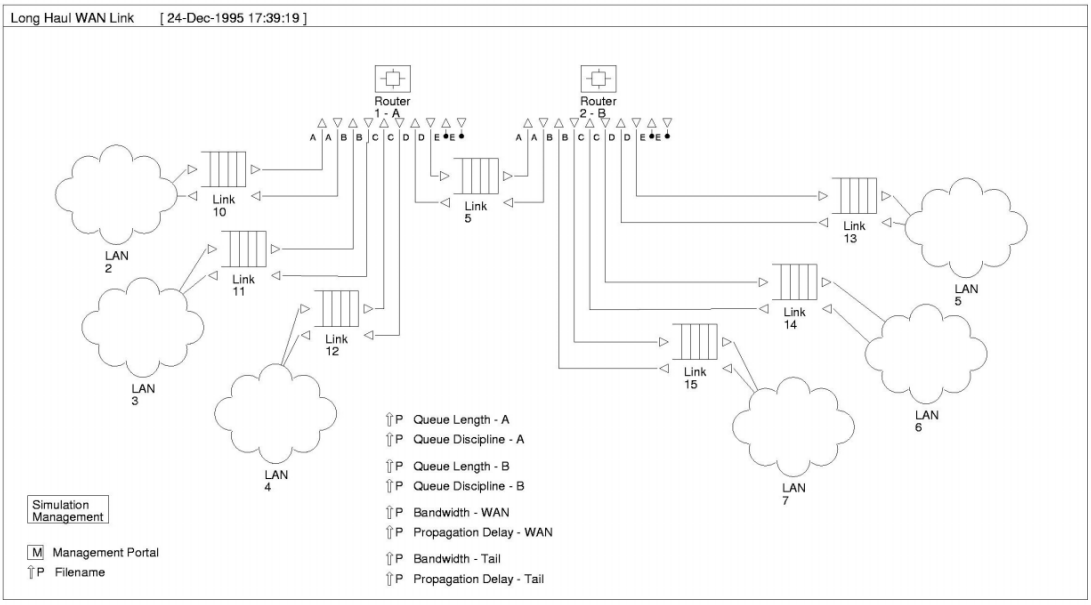

Simple WAN [24-Dec-1995 17:39:03]
Router 1
A A B B C C D D E E
Link A
Link B
Link C
LAN - Traffic A
LAN B
LAN - Traffic C
Simulation Management
M Management Portal
P Filename
P Router: Queue Length
P Router: Queue Discipline
P Bandwidth - A
P Propagation Delay - A
P Bandwidth - B
P Propagation Delay - B
P Bandwidth - C
P Propagation Delay - C


Dynamic WAN [24-Dec-1995 17:39:44]
LAN 4
Router 1
Link 10
Traffic 32
Link 22
Router 2
Traffic 30
Link 20
Link 11
Link 14
Router 4
Traffic 31
Link 21
Router 3
Link 12
Link 15
Link 23
Traffic 33
Link 16
Router 5
Link 13
Link 17
Link 24
Traffic 34
Link 18
LAN 5
Simulation Management
Management Portal
Filename
LAN Host: Queue Discipline
LAN Host: Queue Length
LAN Router: Queue Discipline
LAN Router: Queue Length
WAN Router: Queue Length
WAN Router: Queue Discipline
WAN Traffic: Queue Discipline
WAN Traffic: Queue Length
WAN Link: Bandwidth
WAN Link: Propagation Delay

Simulation Architecture:




Long Haul WAN Link [24-Dec-1995 17:39:19]
Router 1 - A
Router 2 - B
Link 10
Link 11
Link 12
Link 5
Link 13
Link 14
Link 15
LAN 2
LAN 3
LAN 4
LAN 5
LAN 6
LAN 7
Simulation Management
M Management Portal
P Filename
P Queue Length - A
P Queue Discipline - A
P Queue Length - B
P Queue Discipline - B
P Bandwidth - WAN
P Propagation Delay - WAN
P Bandwidth - Tail
P Propagation Delay - Tail


Long Haul WAN Link [24-Dec-1995 17:39:19]
Router 1 - A
Router 2 - B
Link 10
Link 5
Link 13
LAN 2
Link 11
Link 14
LAN 5
Link 12
Link 15
LAN 3
LAN 6
LAN 4
LAN 7
P Queue Length - A
P Queue Discipline - A
P Queue Length - B
P Queue Discipline - B
P Bandwidth - WAN
P Propagation Delay - WAN
P Bandwidth - Tail
P Propagation Delay - Tail
Simulation Management
M Management Portal
P Filename

Problems:

- BONeS was unavailable for a significant part of Thesis 2 (6+ weeks).
- Resulted in non-completion of work, refocus and personal distress.

Level of Completion:

- Completed design and implementation of the BONeS environment, including ‘C’ based TCP and Queue implementation.
- Completed design and outline of expected results for the simulations, except for simulation 5.
- Did not complete execution or analysis of simulations.
- Did make conclusions about problems, and future directions.

Conclusions:

- BONeS is a very good environment for constructing models and simulations.
- There are pressing issues related to TCP congestion control and its operation in current WAN environments.

Future Directions:

- Complete the investigations.
- Investigate these issues in more depth.
- Examine potential solutions to the identified problems, e.g. TCP “super slow start” and T/TCP protocol.
- Match simulation results and real world data.

Thesis 2 Presentation
Spring 1995

Modelling and Simulating Congestion Control in Wide-Area TCP Networks using BONeS

Matthew Gream
(90061060)

Question Time:

(12 minutes)

(text)

- my name is matthew gream

- I am here to present my thesis

- the presentation will consist of a high level overview

- the thesis report contains the detail

- first I will outline the investigation and objectives for the work

- then I will provide an overview of the two main parts in the work

- then I will provide detail on two specific areas in the work

- then I will discuss the level of completion that I reached

- then I will conclude and indicate future directions

- after this, you can question me!

(show)

- the topic

- my name
- my student id
- the semester
- agenda for the presentation
    - investigation and objectives
    - bones environment
    - simulations
    - particular simulation: dwan
    - particular simulation: windowgranularity
    - level of completion
    - conslusions and future directions
    - questions

(show)

- areas of investigation
    - tcp congestion control
    - wan traffic characteristics
    - other
        - modelling and simulations
        - bones
- construct a bones environment to model and simulate wide area tcp congestion issues
    - presentable, re-usable
- use the environment to model and simulate wide area tcp congestion issues
    - examine and describe basic nature of tcp congestion control
    - question the effects of the changing environment
        - complex networks
        - increase in conversation numbers
        - changing in traffic profiles

- originally considered “comparison”, but figured other three were more important

(show)

- constructed using modular and reusable components

- list: components

1. - datalink layer
   - network layer
   - transport layer
   - network-adaption
   - transport-adaption
   - routing-module
   - generator
   - management
2. - host
   - traffic
   - router
   - link
3. - lan
   - lan w/ traffic

- for simulations:

    - different queue drop policies: red, random drop, drop tail

    - different queue extract policies: class, address, length

    - end system: bsd4.4/net3 tcp -- “typical” (‘C’)

    - management script

    - traffic generation

(show)

sim	*objective*	*expectations*
point to point	verify and validate	see basic window oscillation
	explain	see effects of queue lengths and rtt
wan	verify and validate	see effects of rtt bias
	explain	see sharing conditions
dynamic wan	effects of multiple paths	see out of order delivery
	out of order delivery and rtt var	see inrease in retx and so on
overloaded wan link	effects of window granularity	see netwokr breakdown, large rext, see threshold point
	such as loss, etc	

fluctuating wan link	effects of http traffic	see throughput and losses compare against existing traffic

(show)

- simulation:
    - architecture
        - point to point
        - datalink is bottleneck
    - steps
        - setup config
        - run tcp conversation
    - examine
        - tcp stuff
        - throughputs, retransmits and delays
    - expectations
    - graphs

(have)

- levels descending into the tcp and the queue
- expecterd graphs

- simulation:
    - architecture
        - simple wan
        - router is bottleneck
        - share on link 6
    - steps
        - introduce conversation and look at effects
        - introduce traffic levels and look at effects
    - data gathered
        - tcp information
        - throughput and retransmissions
        - rtt bias effects
        - queue alterations
    - expectations
        - rtt bias
    - graph of throughput

(have)

- levels descending into the tcp and the queue
- expecterd graphs

(show)

- simulation:
    - architecture
        - lans separated by lots of wan links
    - steps
        - run single conversation
        - overlay traffic effects
    - data gathered
        - tcp window information
        - queue info
        - throughput and retx
        - iteration with background traffic
        - iteration with x.
    - expectations
        - lots of unrequired retransmissions
        - rtt problems
        - losses due to etc.
    - graph of throughput

(have)

- levels descending into the tcp and the queue
- expecterd graphs

(show)

- simulation:
    - architecture
        - wan link with lots of lans
        - router is bottleneck
    - steps
        - run lots of conversations
        - look at reduction in pipe size
    - data gathered
        - tcp window information
        - queue info
        - transmit and retransmit levels
        - lowering of pipe size
        - increasing of bandwidth
    - expectations
        - significant loss
        - terrible loss below threshold
        -

- graph of breakdown

(have)

- levels descending into the tcp and the queue
- expected graphs

- simulation:
    - architecture
        - wan link with lots of lans
    - steps
        - run long deep conversations
        - run lots of overlapping conversations
        - try for http and for poisson case
        - examine losses for individual cases and overall
    - data gathered
        - throughtput and retransmit
    - expectations
        - lots of losses
    - graph of throughput

(have)

- levels descending into the tcp and the queue
- expecterd graphs

(show)

- bones problems occurred for 6 weeks of thesis

- concentrated on documenting existing work (design, implem)

- completed the environment

- completed the deisgn for the simulations and expected results

-

(show)

- there are pressing issues related to congest control and current wans

- simulations need to be run

- potential solutions need to be devised and tested

    - e.g. t/tcp protocol

    - super slow start window

- more simulations of a “big” nature

(show)

- topic
- question time: 12 minutes